Ukamaka Ezimora
High School Engineering Portfolio
2018-2020

Ukamaka Ezimora

Elk Grove, CA 95757

Education

Franklin High School (Graduation May 2020)-Elk Grove, CA

Member of :

- National Honors Society
- Key Club
- EGUSD Student Ambassador: Engineering & Technology Pathway
- Black Student Union
- Book Club
- Mathematics Engineering Science Achievements (MESA)
- WASC Student Group Committee

Awards:

- Multiyear Honor Roll
- 400+ Hour Community Service Award
- AP Scholar
- President's Award for Educational Excellence
- Golden State Seal Merit Diploma

Work Experience

Franklin Library-Elk Grove, CA

- Library shelver (volunteer)

Skills and Experiences

- Photoshop
- Yearbook Committee (3 years total, Middle & High School)
- Drill Press
- Bandsaw
- Jigsaw
- Radial Arm Saw
- Pneumatic Cylinder Lap 2
- Hand Drill
- Manual Sander
- Orbital Sander
- 3D Printer
- TinkerCAD
- Electrical Systems
- VEX Robotics
- ROBOTC
- Panel Saw
- Solenoids
- DC Motor
- Push Buttons
- Limit Switches
- Relays
- Laser Cutter
- CAD
- Welding

Leadership and Activities

- Track and Field (2 years, Middle School)
- Vocal Women Acapella Group (1 year, High School)

Table of Contents

Project

Introduction

Hello. My name is Ukamaka Ezimora, and I am an Engineering student at Franklin High School. This portfolio is made to enhance my resume by showing my Engineering project experience. The Principles of Engineering program at Franklin is a program with various benefits. One of which is the individual projects. In these projects, we strengthen important skills such as independence. By not being given many specific directions, we learn independence, or how to think for ourselves. Instead of relying on others and their knowledge on where to use what tool and how, we have to rely on our own intellect and use context clues in order to succeed. Thank you for taking a look at my projects.

About Me

Ever since I was a kid, I've loved making things. From going through my DIY jewelry sets, to building my own light dome, I've gotten used to making things. Recently I've taken up the hobby of sewing where I essentially put together puzzle pieces made of fabric. I think that's why I'm interested in Engineering. The whole process of starting from scratch to build something that functions well, or to tear something apart and see how it works, excites me. The MESA club that I joined last year gave me an outlet where I could explore my mechanical engineering side and see where that takes me. I like making my own creations whether it be a button up shirt, or something made out of wood. In the near future, I hope to be a successful engineer.

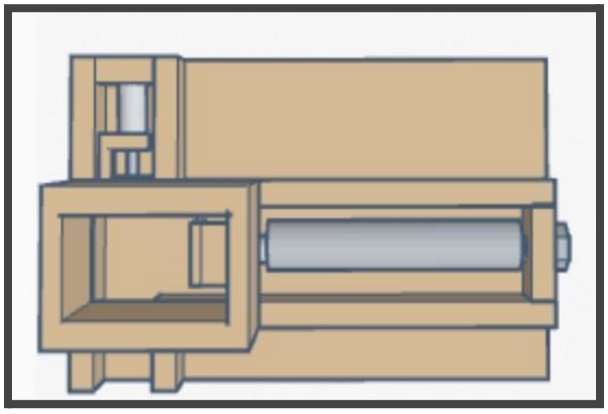
MESA
Math · Engineering · Science
Achievement

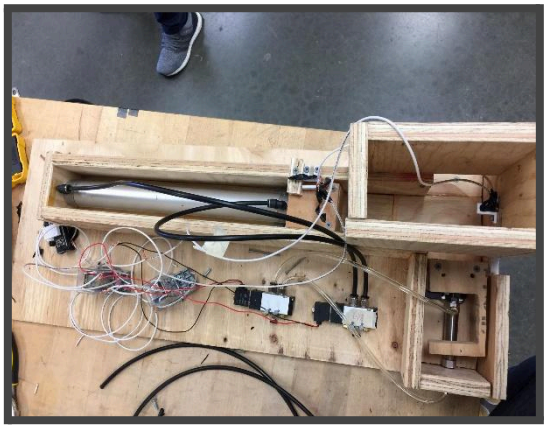
Can Crusher

For *Principles of Engineering A*, my four teammates and I designed and built an automatic can crusher as a group assignment in our class. The goal of the assignment was to build an automated can crusher that reduced the volume of cans by at least seventy percent and had the capacity to process one hundred and eighty cans per hour. Our can crusher had to use a pneumatic cylinder to crush the cans with some type of mechanism. We also had to design a can ejection system that ejected the cans by utilizing one of the six simple mechanisms, was triggered by the retract stroke of the can crusher, and did not simply drop the cans through a hole. We were also required to have an electric relay control system that controlled the pneumatics. The system was to consist of relays, push buttons, and switches. These switches had to be placed in the path of the pneumatic cylinders' start and end. We were provided with workbooks on how these electrical and pneumatic systems worked so that we could better understand the project.

We created our basic mechanical wood structure with a large sheet of balsa wood, which we cut and manipulated with various tools, such as the bandsaw, jigsaw, drill press, radial arm saw, hand drill, and manual sander. We used 3D printing machines and Tinkercad to aid in the building of both the pneumatic system and the electrical system. While designing our prototype, we paid no mind to the amount of wood we were using, due to the abundance of scrap wood that was available. We did, however, pay attention to the material constraints of the electrical and pneumatic systems and redesigned pieces as needed. Screws, nails and wood glue were an integral part of our project, as they were used to combine all the components of our project. Aside from the 3D printed pieces and the machinery of our project, all of the parts were handmade by our team. I spent many hours before school and during class time, to add to and improve our project.

In the end, our project was unsuccessful due to many factors such as: little to no contribution from team members, poor distribution of tasks, and team members failing to do their job. Although this may have been a bit of a stressful and traumatizing experience, I learned a lot from it. I learned how to think for myself and solve my own problems. I gave my all in the project and gained valuable experience on how to be a leader.



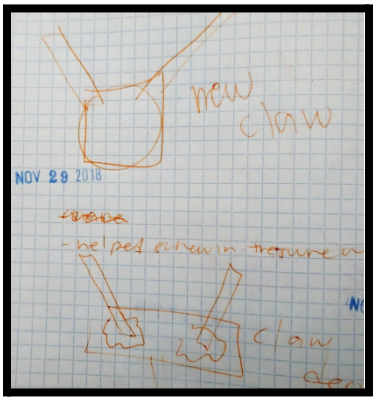


Robot

For *Robotics*, my two teammates and I built and programmed a robot. The robot was a group assignment in our class. The goal of the assignment was to build a robot arm that could bring a cone from one stool to another without dropping it. The stools were to be set 6 feet apart in length. Our robot had to follow a path while it picks up the cone and be able to complete it two times in a row. We were also required to only use the parts we had to redesign our robot. We had to also program our robot with knowledge we gained from our past coding video lectures. The code was to consist of turns, forward controls, backward controls, and arm controls. These turns and such had to be perfect, so that the robot would not move or disturb anything in the course. We were given about two weeks to complete the project.

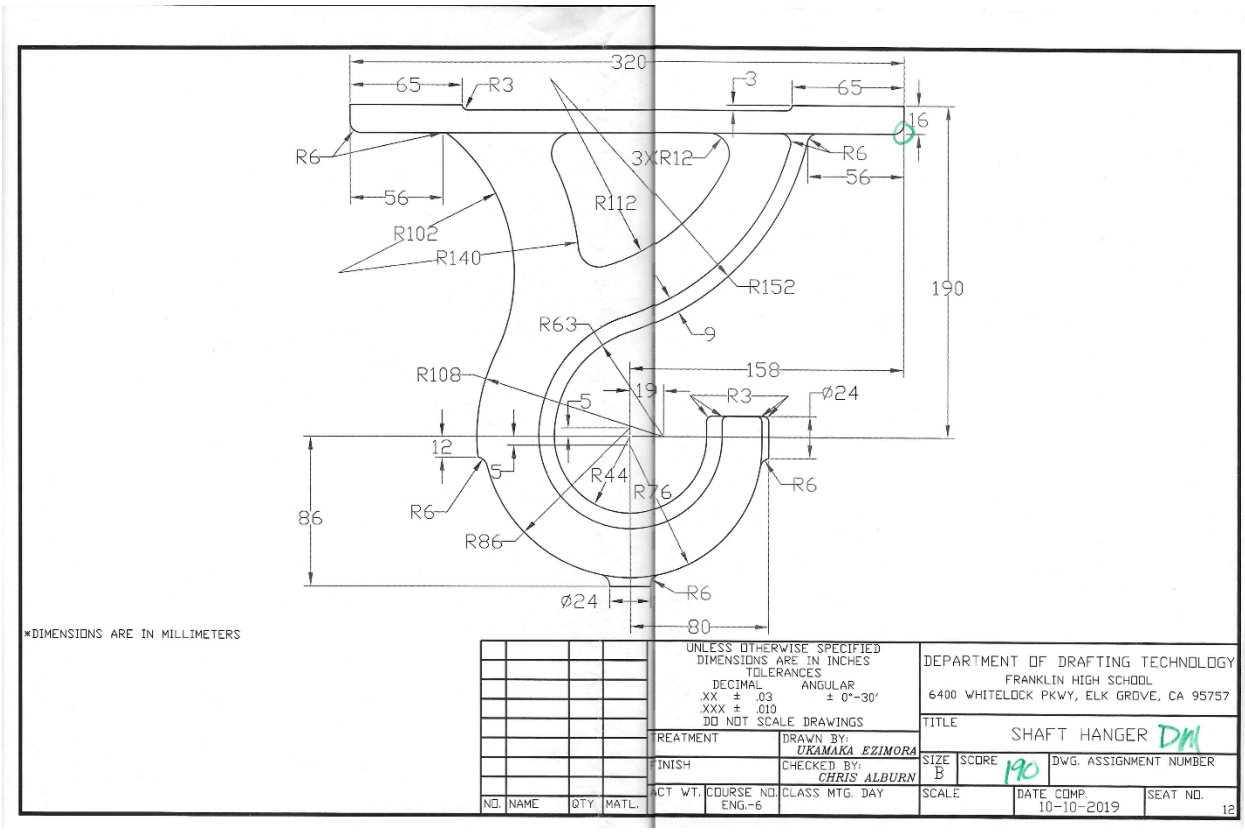
We created our basic robot structure with screws, metal pieces, gears, and wheels which we bent and manipulated with hammers. We used wrenches and our hands to aid in the building of the robot. We designed and placed the gear system around the robot arm, and were careful to not make the arm too heavy, as then the robot would topple over easily. To maintain balance, we added a wheel at the back of the arm to act as a weight to keep everything steady.

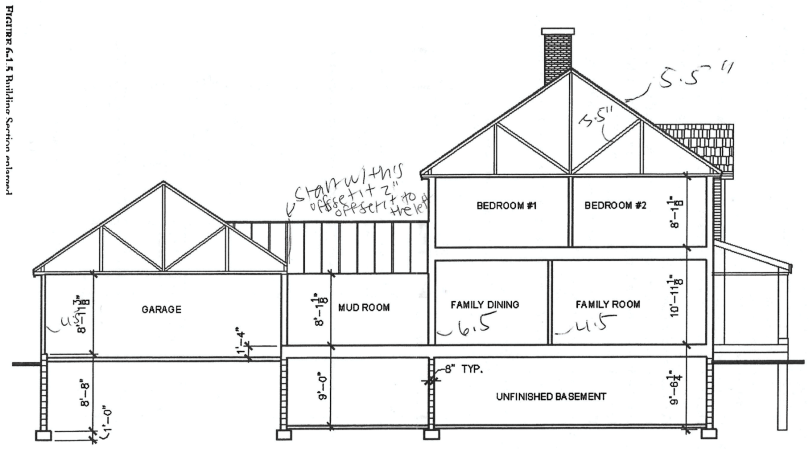
Our robot often lost some screws during testing, or had loose wheels, which made the coding take longer and sometimes be inaccurate. In the end, our project was slightly successful due to the contributions from my group members. Although our teamwork wasn't great, I learned how to use my time efficiently and effectively.



AutoCAD

AutoCAD is a computer-aided design program used for 2D and 3D design and drafting. It is used in jobs like construction and manufacturing. AutoCAD is developed and marketed by Autodesk Incorporated and was one of the first CAD programs that could be used on personal computers. Its first release used only simple things such as polygons, circles, lines, arcs and text to create complex objects. Later, it began to support custom objects through a C++ application programming interface. The modern version of the software allows for solid modeling and three dimensioning.



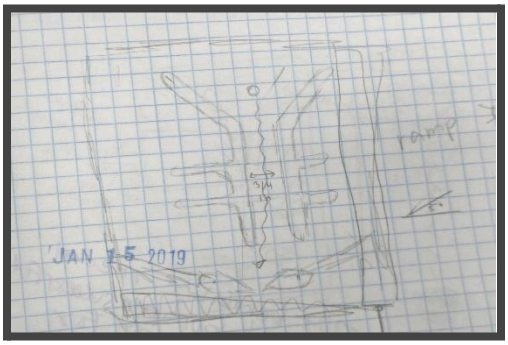


Pinball Machine

For *Principles of Engineering A*, my five teammates and I designed and built a pinball machine as a group assignment in our class. The theme of our pinball machine was inspired by one of our members. The goal of the assignment was to build a pinball machine that was fully automatic, with bumpers that were activated by two limit switches and a game that was activated by two push buttons. Our pinball machine had to use solenoids to move the flappers up and down with some type of mechanism. We also had to design a limit switch system in which the bumpers were activated by the ball hitting it, not by us manually hitting the switch, or by the plunger hitting the switch. We were also required to have an electric relay control system that controlled the flappers and bumpers. The system was to consist of relays, push buttons, and switches. These switches had to be placed in the path of the pinball's start and end. We were provided with workbooks on how these electrical and pneumatic systems worked and also with a hands-on demonstration during class so that we could better understand the project.

We created our basic mechanical wood structure with a large sheet of balsa wood, which we cut and manipulated with various tools, such as the bandsaw, jigsaw, drill press, radial arm saw, hand drill, manual sander, and panel saw. We used 3D printing machines and TinkerCAD to aid in the building of both the pneumatic system and the electrical system, which were connected and hidden underneath the pinball machine surface. While designing our prototype, we paid no mind to the amount of wood we were using, due to the abundance of scrap wood that was available. We did, however, pay attention to the material constraints of the 3D printed pieces as they were running out of plastic. Screws, nails and wood glue were an important part of our project, as they were used to combine all the components of our project.

Aside from the 3D printed pieces and the laser cut parts of our project, all of the parts were handmade by our team. I spent many hours during class time, to add to and improve our project. In the end, our project was successful because of the many skilled members of our team and ability to work as a team. From this experience, I learned about how to contribute more in group discussions and not be afraid to share my opinion. Note that in the photo, the metal plunger on the left side of the pinball machine has been taken out.

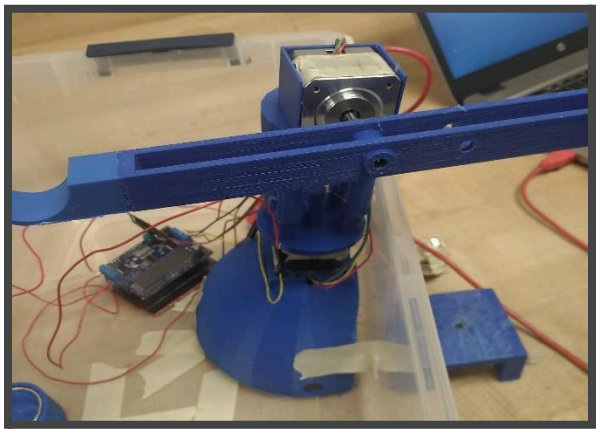


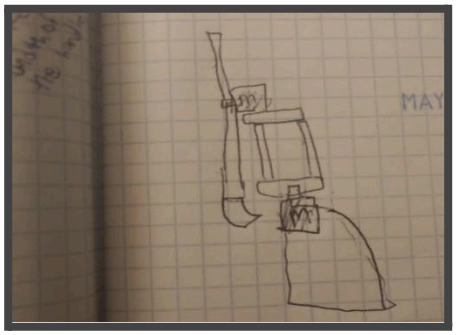
Robotic Arm

During term four of Robotics with Mr. Martins we were given the challenge of creating a robotic arm from scratch. We were only provided with access to the 3D printers-stocked full with PLA filament, access to Inventor or TinkerCAD, hot glue guns, four stepper motors, sanders, a dremel, chisels, and the rest of the tools in the engineering workshop. Though the task in itself was easy, it was made difficult with the requirements that were placed on our product. While picking up a stand that is no more than one inch high, the robotic arm could not extend to lengths higher than fifteen inches. Picking up the object from its one inch stand, the arm had to rotate ninety degrees, then place the object outside the box on a stand no higher than two inches.

When our assignment was given to us, I was confused at first on what the robot had to do. I thought the robot had to pick up the object and place it somewhere ninety degrees inside the box. Therefore, I thought a stepper motor run “car” with wheels and a claw at the front would be the best design. However, my dreams of getting an easy A were quickly crushed as soon as I asked Mr. Martin to clarify things for me. Then, I quickly thought of a new design. One stepper motor would rotate a cylindrical base on which the arm would be placed. The cylindrical base would have two rectangular holes on the sides for the gear and arm hybrid contraption to move forward and backward freely. A long rod that is attached to the base would hold up that arm and gear hybrid to provide stability. A long gear glued to a stepper motor would be behind that arm and gear hybrid to turn the gear, moving the arm forward and backward. However, this idea wasn’t possible as the gear that was attached to the stepper motor wasn’t secure and the surface was too small to hold so many parts. Thinking back on it, I should have used some of the gear belts that were provided to us, resized them, fit them tight to the gear, and seen if that would keep it stable. I had created two more designs that also had problems with them too. It was either that the motor was too weak to lift it up, or the base wasn’t stable enough. Our major problem was just strength and balance. However, our last design quelled all of our fears of not finishing and was balanced, not too heavy for the motor, and was easier to code.

Through this project, I learned how to recognize patterns in behavior. By analyzing why certain parts of my design did and didn’t work, and by analyzing the patterns of what did and didn’t work with my classmates. In future projects, when I’m out of college and go into product development, I can use this experience to come up with solutions more effectively and accurately.





Go Kart

During term two of Principles of Engineering with Mr. Martins we were given the challenge of creating go-kart from scratch. We were provided with an old group's go kart creation to take old parts from, four big batteries, one motor, an accelerator potentiometer, a pneumatic brake, some scrap metal, and a quick tutorial on welding. Though the task itself was easy, it was made difficult with the requirements that were placed on our product. The frame could not exceed 5' in length or 2' in width, it had to be between 3" off the ground but could not exceed 6", all components, like the batteries and motor had to be secured and mounted, batteries had to be mounted behind the driver, front wheel axles could not be wider than rear wheel axle, and the rear of go kart could not be lower than front of go-kart.

When the assignment was given to us, I was a little bit intimidated. Though we had a basic design to base our go-kart off of, I knew that we'd run into some problems, where the previous group had failed to complete the assignment. My group and I ran into the most issues with pedals and leg room availability, but we managed to revise our previous design and successfully fixed the problems for testing. Our go kart did turn out the way we planned and designed it for the most part. Along the way, we did have to make changes constantly, especially toward the completion of the project. The length between the pedals and seat were awfully close and nobody was able to press on the pedals safely. We cut off the brackets and pedal placeholders the next day and decided to re-weld them more towards the front of the frame. The new placement gave around 8 inches extra in leg room so we went to get the go kart approved. Tightening and placing everything in place again, we had Mr. Martins sit in the kart again, and the spacing was okay. Our major problem was spacing and placement.

Through this project, I learned how to strengthen my deductive reasoning skills.. By analyzing why certain parts of my design did and didn't work, and by analyzing the patterns of what did and didn't work with my classmates, we were able to make a successful go-kart.